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## COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS.

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## BOYS' AND GIRLS' CLUB WORK.

## HOME GARDENS.

## INSECTS AND DISEASES OF VEGETABLES AND HOW TO COMBAT THEM.

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## INTRODUCTION.

Although all garden vegetables are likely to be attacked by diseases and insects, some of them will pass through the season without harm of any kind. It is not safe, however, to trust to luck or to risk losing a part or all of the crop by neglecting to take necessary precautions against disease and insect control. To a person with little or no experience in spraying, it seems like a formidable task to prepare and apply the different spray mixtures, but it is not such an intricate undertaking when one gets into the spirit of it. By following directions closely one ought to be able to prepare and apply the spray mixtures with marked success.

The instructions given in this circular must necessarily be very brief, and are particularly for those who have small gardens and need small quantities of spray mixtures. Those who desire fuller information on particular diseases or insects may secure such information from their State agricultural college or from the United States Department of Agriculture, Washington, D. C.

## SPRAY PUMPS.

For garden use the bucket pumps (see fig. 1), the small compressed-air sprayer (see fig. 2), and the hand sprayer or small atomizer sprayer (see fig. 3) are best. The last one mentioned is very cheap and will be entirely satisfactory for the small garden.

Small spray pumps may usually be purchased at the local seed and hardware store, or from seedsmen in the cities.

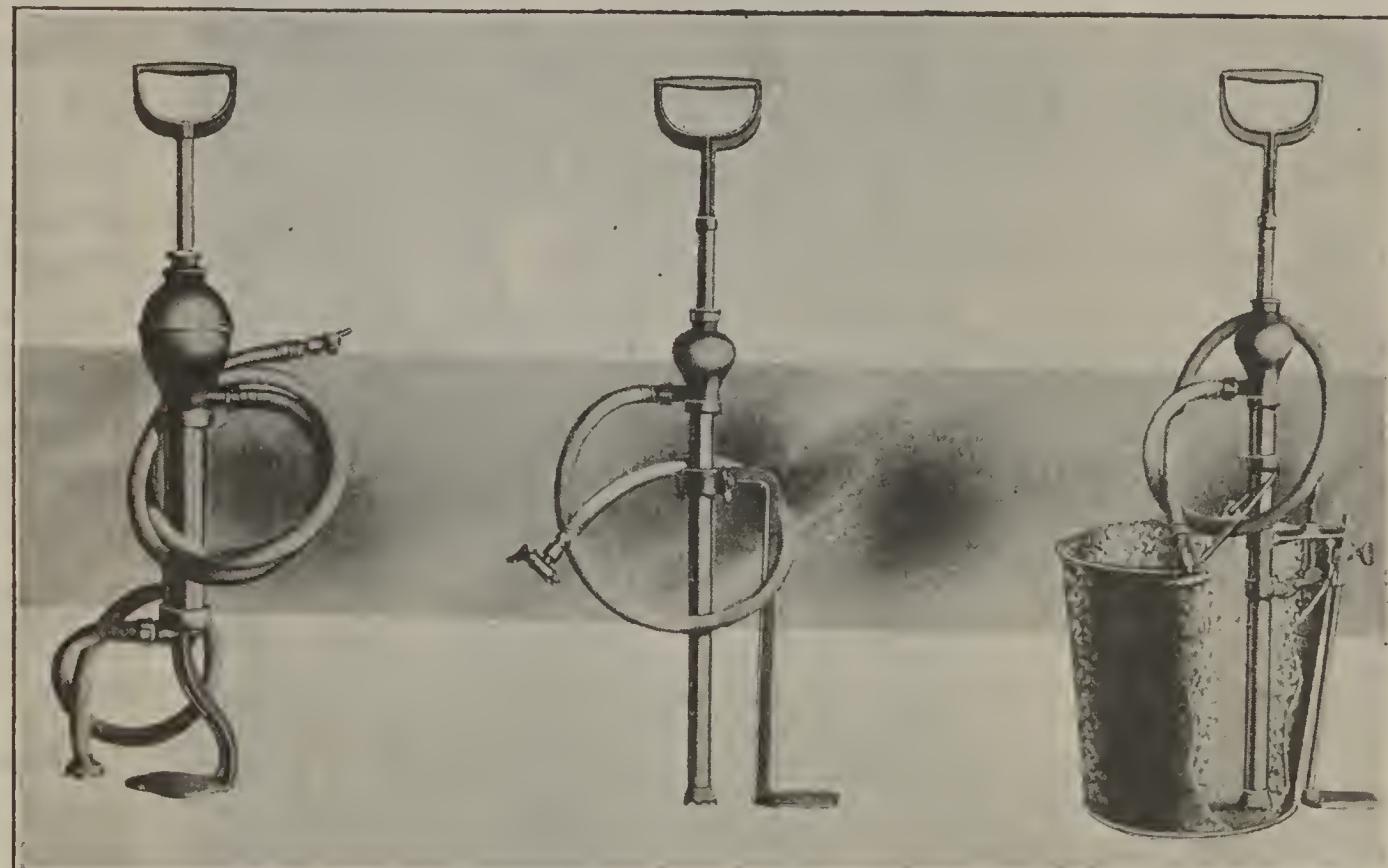


FIG. 1.—Bucket spray pump suitable for use in gardens. These pumps sell for about \$4 or \$4.50.

If a spray pump is not available, the spray mixture may be roughly applied with a sprinkling pot, which is very wasteful, or it may be "spattered" on the plants with a whisk broom. The whisk broom was used for this purpose before spray pumps were invented.

#### SIFTERS OR SHAKERS.

Powdered arsenate of lead or Paris green mixed with air-slaked lime, road dust, or sifted ashes may be dusted or sifted on the plants by means of a cheap flour sifter or other similar sifter. A tin can with small holes punched in the bottom makes a very serviceable sifter for this purpose. Sulphur may be applied with a sifter. If plants are wet with dew the dusting material sticks to them very well.

#### FUNGICIDES, OR TREATMENT OF PLANT DISEASES.

Fungicides are preparations for the control of plant diseases. Most of the diseases mentioned in this circular are caused by some fungus, so the diseases are called fungus diseases and the remedies fungicides. The best fungicide for garden diseases is Bordeaux mixture, which is made as follows:

##### BORDEAUX.

Copper sulphate or blue stone	ounces..	6
Lump lime	do....	6
Water	gallons..	5

Dissolve the copper sulphate in about 2 quarts of hot water and dilute this with cold water to make  $2\frac{1}{2}$  gallons. Use a wooden or earthen vessel for this purpose. Slake the lime and dilute with water to make  $2\frac{1}{2}$  gallons. Pour the copper sulphate solution slowly into the lime water while stirring vigorously with a paddle. This is Bordeaux. *Be sure to use fresh lump lime.*

FIG. 2.—Spraying a rosebush with compressed-air sprayer. This is one of the best types of small sprayers for garden use. Prices range from \$5 to \$8.50, depending upon whether the tank is made of galvanized iron or brass.

Bordeaux is not of itself a remedy to be used against insects except as it repels flea beetles from the potato, eggplant, and other plants. If, however, arsenate of lead or Paris green is added to Bordeaux one of the best combination sprays for both chewing insects and diseases is the result. Bordeaux and nicotine sulphate make a splendid combination spray for plant diseases and sucking insects.

Strain the Bordeaux, so that it does not clog the nozzle while being sprayed.



It is a good plan to slake a few pounds of lime and keep it for use as needed. If kept covered with a little water it will keep for months and may be used in any of the mixtures requiring lime.

Concentrated Bordeaux is sold in sealed packages in small or large quantities by seedsmen and perhaps by most local dealers who handle spray pumps. Trade names have been given to some of the Bordeaux preparations, and some of these contain poison for combating leaf-eating insects.

#### SULPHUR.

Pulverized sulphur or flowers of sulphur is used to control mildew by dusting it full strength on the diseased plants.

#### INSECTS.

One particular point to remember about insects is that there are two classes, one that *sucks* its food and one that *chews* and *swallows* its food. Among the first class which suck the sap of plants are the true bugs and plant lice or aphids, as the squash bug and "melon louse." These insert their beaks into the plant tissue and suck the sap just as a mosquito inserts its beak and sucks blood from a person or animal. These can not be poisoned, so must be killed by a spray mixture coming in contact with their bodies.

The other class—potato beetle, cabbage worms, cut-worms, and others—eats the leaves of plants, and either the mature insect or the "worm," larva, may do this eating. These are killed by eating the poison sprayed or dusted on the plants or mixed into poisoned bait.

#### INSECTICIDES, OR TREATMENTS FOR INSECTS.

Insecticides are preparations for the control of insects. These are of two classes—contact mixtures for sucking insects and poison mixtures for chewing insects.

##### Contact Insecticide.

###### NICOTINE SULPHATE.

Nicotine sulphate (40 per cent).....	ounce..	1
Laundry or other soap.....	do....	1
Water.....	gallons..	4

Dissolve the soap and add it and the 40 per cent nicotine sulphate solution to the water. This is one of the simplest and most effective contact sprays.

A stock of dissolved soap may be kept on hand in a glass jar ready for instant use. It does not matter if an excess of soap is used.

Remember this is only for *sucking* insects. Spray as early as possible and as often as necessary to control them. The aphids or plant lice usually collect on the underside of leaves, and their injury to the leaves causes them to crumple, with the edges turned down, thus protecting the aphids. It is difficult to reach aphids with the spray when the leaves are much crumpled. Leaves badly attacked with aphids in this way should be picked and burned.

This remedy will kill the aphids on other plants like rosebushes, ornamental shrubs, and fruit trees.

If 4 gallons of Bordeaux instead of water are used with nicotine sulphate and soap, both sucking insects and plant diseases may be combated with this combination spray.

Nicotine sulphate is sold by most seedsmen.

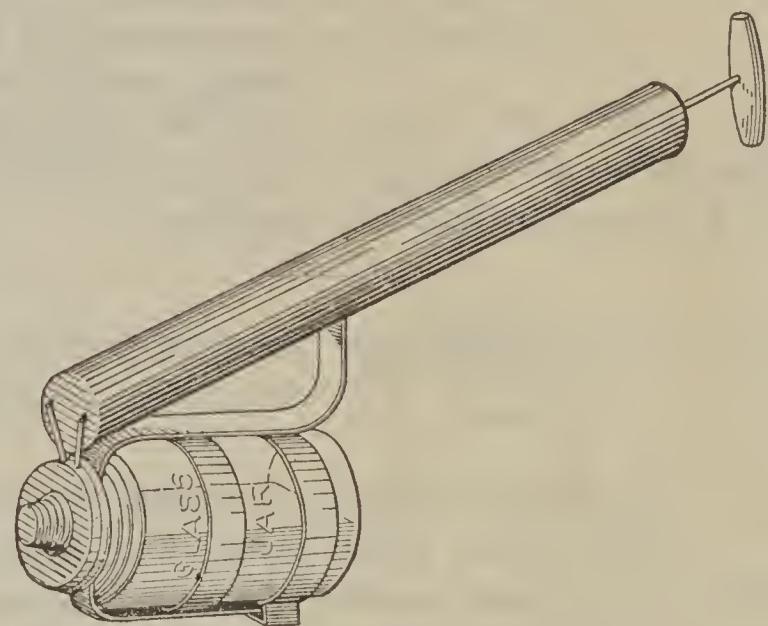


FIG. 3.—Hand sprayer or small atomizer sprayer. This one with glass receptacle for holding spray mixture is better than those with metal receptacle. These are sold at from 50 cents to about \$2.

## Poison Insecticides.

## ARSENATE OF LEAD.

Arsenate of lead (powder).....	ounces..	2
Water.....	gallons..	3
Or		
Arsenate of lead (paste).....	ounces..	4
Water.....	gallons..	3

Arsenate of lead is one of the best poisons to use because it mixes evenly in water or Bordeaux and sticks well to the foliage. The powder form is more convenient to handle and weigh than is the paste. It should be kept well stirred while being sprayed so as to spread the poison evenly over the plants.

If both insects and diseases are to be controlled, Bordeaux should be used instead of water, thus making one of the best combination sprays for both plant diseases and chewing insects. One spraying will then take the place of two simple sprayings.

Arsenate of lead should not be used on cabbage or cauliflower after the heads begin to form.

## ARSENATE OF LEAD (APPLIED DRY).

Arsenate of lead (powdered).....	ounce..	1
Air-slaked lime, dry road dust, or sifted ashes.....	pounds..	3

These are mixed together and dusted onto the plants with any kind of a sifter. This should be done in the morning while the plants are wet with dew. Arsenate of lead is preferred to Paris green for this purpose.

## PARIS GREEN.

Paris green.....	ounce..	1
Lime (lump).....	ounces..	2 to 4
Water.....	gallons..	10

For potatoes use only 6 gallons of water instead of 10.

When Paris green is used in water, lime must be added to prevent injury to the foliage. The lime should be slaked in the ordinary way; air-slaked lime will not do.

If Bordeaux instead of water is used, this lime is not necessary. Paris green is heavy and settles quickly if the mixture is not stirred while being sprayed. Bordeaux and Paris green together make a good combination spray for plant diseases and chewing insects. Paris green should not be used on cabbage or cauliflower after the heads begin to form.

## PARIS GREEN (APPLIED DRY).

Paris green.....	ounce..	1
Air-slaked lime, dry road dust, or sifted ashes.....	pounds..	3

Paris green in lime, road dust, or ashes is often used dry by being sifted on potatoes and other plants to kill chewing insects.

The high price of Paris green at present prohibits its use, but since arsenate of lead is replacing it and is better in every respect, no hardship to the gardening public will follow the temporary passing of Paris green.

## PYRETHRUM OR INSECT POWDER.

Pyrethrum.....	ounce..	1
Water.....	gallons..	2

One ounce of pyrethrum in two gallons of water is the best spray for vegetables like cabbage, cauliflower, etc., after heads have begun to form, because it is not poisonous to people like arsenic is.

Pyrethrum may also be used full strength as a dry powder, being dusted on the plants with a bellows or powder shaker.

**Combination Sprays for Plant Diseases and Chewing Insects.**

**BORDEAUX-ARSENATE OF LEAD.**

Bordeaux.....	gallons..	3
Arsenate of lead (powder).....	ounces..	2
Or		
Bordeaux.....	gallons..	3
Arsenate of lead (paste).....	ounces..	4

**BORDEAUX-PARIS GREEN.**

Bordeaux.....	gallons..	10
Paris green.....	ounce..	1

For potatoes use 6 gallons of Bordeaux instead of 10.

The advantage of these combination sprays is that both plant diseases and chewing insects may be sprayed for at one time, thus reducing the labor of spraying one-half. They should always be used if possible.

For spraying cabbage and cauliflower before the heads form, resin Bordeaux instead of Bordeaux should be used with arsenate of lead or Paris green.

**Combination Spray for Plant Diseases and Sucking Insects.**

**BORDEAUX-NICOTINE SULPHATE.**

Bordeaux.....	gallons..	4
Nicotine sulphate.....	ounce..	1
Laundry or other soap.....	do....	1

This combination spray is for plant diseases and sucking insects, especially aphids. It should be used whenever disease and aphids are both present on plants.

**POISONED BAIT.**

Wheat bran.....	pounds..	2
White arsenic (powdered).....	ounce..	1
Cheap sirup.....	ounces..	2 or 3
One lemon or orange chopped fine.		
Water—enough to make thick mash.		

Mix bran and white arsenic together and dilute the sirup with a little water.

Pour diluted sirup over the bran and white arsenic, add the lemon or orange, stir well and add enough water to make a thick mash. Place very small portions of the bait around plants subject to attack by cutworms or slugs. Also place bait beneath chips or small pieces of boards under which the cutworms and slugs collect and may eat it during the day.

**SLUGS.**

Slugs are worm-like creatures which often eat young lettuce and many other plants. They are particularly fond of ripe tomatoes and other vegetables, strawberries, and some other fruits. The poisoned bait just mentioned is the remedy for them. They feed at night and hide under cover of some kind during the day. The bait should be placed wherever they happen to become injurious.

**HOW TO USE THESE INSTRUCTIONS.**

The reader should consult the spray calendar which follows and gives the names of vegetables arranged alphabetically, the diseases and insects attacking them, and the kind of spray to use for each, and the time different sprayings should be applied. After deciding which spray is to be used he should refer to the discussion of that particular spray to find out how it should be prepared, and use it exactly as stated.

SPRAY CALENDAR FOR GARDEN DISEASES AND INSECTS.

Plant.	Disease or insect.	Spray to use.	First spraying.	Second spraying.	Third spraying.	Remarks.
Asparagus . . . . .	Rust. (Rusty appearance of leaves and stems.) Beetles. (Eat the young stems and leaves.)	Arsenate of lead . . . . .	When beetles appear on young plants. On old plants after the cutting season.	10 days later . . . . .	10 days later if necessary.	Secure a rust-resistant variety, such as Reading Giant, or Palmetto. Arsenate of lead must not be used on the new stems during the cutting season.
Bean (bush) . . . . .	Anthracnose. (Dark, sunken, scab like spots on pods and spots on leaves.)	Pick and burn diseased pods.				This disease is carried on the seed, so seed from healthy plants only should be saved. All diseased plants should be burned. Do not cultivate when plants are wet.
Beets . . . . .	Bacterial blight. (Water-soaked spots on leaves and pods.) Aphids or plant lice. (Suck sap from all parts of the plant and cause leaves to crumple.) Leaf-beetles. (Beetles are very small, dark, or pale striped and eat the leaves.)	No satisfactory remedy.	When aphids first appear.	Repeat when necessary.	Repeat when necessary.	Pick and burn crumpled leaves which protect the lice from the spray.
Brussels sprouts . . . . .			When beetles appear . . . . .	Repeat if necessary . . . . .		Bordeaux repels these beetles to some extent but does not kill them.
Cabbage . . . . .	Leaf spot. (Spots reddish and purple then turn ashy gray.) Web worm. (Eats the leaves.) . . . . . Beet flea beetles. (Small beetles eat the leaves.) Spinach aphid. (Sucks sap from the leaves.)	Bordeaux . . . . . Arsenate of lead . . . . . do . . . . . Nicotine sulphate . . . . . do . . . . .	When plants are 3 to 4 inches high.	When worms appear . . . . .	Two weeks later . . . . .	Usually garden beets do not need spraying.
Cabbage . . . . .	Club root. (Root swells and decays.)	Pull up and burn plants.				In the spring apply 1 pound of lime to each 8 square feet of ground before plants are set out.
Cabbage . . . . .	Black rot. (Leaves turn yellow then brown, then black, and decay.)	do . . . . .				This is a bacterial disease not controlled by spraying the plants. The seed should be soaked for 15 minutes in formalin, $\frac{1}{4}$ ounce to 3 pints of water, or in corrosive sublimate, 15 grains to 1 quart of water, then rinse seed in clean water and either plant or dry it. The remarks above apply to yellows also.
Cabbage maggot. (Tunnels inside the roots.)	Yellows. (Leaves turn yellow, then brown, and finally drop.) Black leg. (Diseased sunken areas on stem, leaf stem, midrib, and margin of leaves, plant takes on purplish tint.)	Pull up and burn plants.	Pull up and burn diseased plants.	On seed bed sprinkle 2 quarts of Bordeaux on each 5 square feet as soon as seed is planted.	Repeat just before plants are taken out of seed bed.	Tarred paper disk, as described under "Remarks."

Cabbage worms. (Eat the leaves.)	Arsenate of lead	When worms appear ... Repeat if necessary ... if heads have not formed.	Repeat if necessary ... do ...	the ground; this will prevent young maggots from reaching the root of plant. Do not use Paris green or arsenate of lead after heads form. A little soap in the water will make these poisons stick better. Pyrethrum may be used after the heads form.
	Pyrethrum	do ...	Repeat if necessary ... do ...	Cutworms are abundant in sod, and crops on freshly plowed sod are likely to be badly injured. Wrap paper around stem from root to leaves just before plants are set.
Aphids or lice. (Suck sap from leaves.)	Nicotine sulphate	When aphids appear ... Repeat if necessary ... do ...	Spread poisoned bait around plants as necessary to control worms.	7
Cutworms. (Dark-colored worms, eat plants off at surface of ground.)	Poison bran mash or clover dipped in Paris green and water.	Spread poisoned mash or clover over ground before cabbage plants are set out and around plants as soon as set.	Do not use Paris green or arsenate of lead after the heads begin to form.	
Cabbage looper. (Eats the leaves.)	Same as for cabbage worms.		Will probably not need treatment.	
Cauliflower	Same as cabbage, which see			
Carrot				
Celeriac	Same as celery, which see ...			
Celery	Bright or leaf spot. (Gray or brown spots, stems droop.) Damping off. (Little seedlings die in seed bed.)	Bordeaux on young seedlings in seed box or seed bed.	10 to 14 days later ...	The seed bed spraying is very important to prevent the disease from becoming serious. Young celery seedlings should be carefully watered and partially shaded in hot, dry weather.
Chard	Leaf spot ...	As soon as set in garden.		If disease appears, spray as directed for beets.
Corn	Smut. (Large, black, irregular swellings on ears or tops.) Cutworms. (Dark worms which cut small corn plants off at surface of ground.)	Usually no spraying is necessary.	Repeat if necessary ... do ...	Cut off and burn smut swellings. Cutworms work mostly at night. In the morning they may usually be found in the ground by a cut-off plant. Dig them out and kill them. They are worst on land recently in sod. Kill all worms found when corn is husked for use.
Corn ear worm. (Bores through husk and eats young kernels.)	No satisfactory remedy.	No satisfactory remedy. Poisoned bait as mentioned under cabbage.		
Cucumber	Anthracnose. (Brown spots on leaves.) Downy mildew. (Yellow spots on leaves.) Wilt. (Leaves droop and wilt in a short time.) Striped beetle and 12-spotted beetle. (These eat the leaves.)	Bordeaux	When plants begin to form vines. do ... do ...	Repeat if necessary. Do. Control striped beetles, which spread the disease. Repeat as often as necessary.
Vine borer. (Worm bores in vine at surface of ground.)		Pull up and burn plants. Arsenate of lead in the Bordeaux used for diseases; or tobacco dust; or cover plants with cloth or wire gauze protectors. Cut vine lengthwise and remove and kill borer.	2 weeks later ... do ... do ... 5 days later ...	Throw earth over vines every few feet so that new roots will form at these places.

Spray calendar for garden diseases and insects—Continued.

Plant.	Disease or insect.	Spray to use.	First spraying.	Second spraying.	Third spraying.	Remarks.
Cucumber . . . . .	Stink bug or squash bug. (Sucks sap from leaves and injects poisonous substance into leaves.)					Pick the bugs or shake them into a pan containing a little kerosene. Also destroy egg masses. Bugs will collect under small pieces of boards placed near the hills and are then easily crushed.
Eggplant . . . . .	Blight or wilt. (Whole plant wilts.) Anthracnose. (Dark sunken spots in fruit, cracks in leaves.) Flea beetle. (Small jumping beetle which eats leaves.)	Pull up and burn plants. Bordeaux . . . . .	10 days later . . . . . When plants are set . . . . .	10 days later . . . . .	10 days later . . . . .	This is a difficult disease to control.
Endive . . . . .						Not likely to be injured by pests.
Kohlrabi . . . . .						Not likely to be injured by pests.
Lettuce . . . . .						Garden lettuce is seldom injured by diseases or insects, but slugs may attack it.
Muskmelon . . . . .	Anthracnose. (Dark spots on leaves; long light brown spots on stems; deep round spots on melons.) Leaf blight. (Small dark spots on leaves.) Striped cucumber beetle . . . . . Spotted cucumber beetle . . . . . Flea beetle. (Eats the leaves.) Spanish vine borer. (Worm bores into vine at surface of ground.) Aphids or lice. (Suck sap from leaves.)	Bordeaux . . . . .	When plants begin to form vines . . . . .	Two weeks later . . . . .	Two weeks later . . . . .	Repeat if necessary.
Onion . . . . .	Thrips. (Small sucking insects . . . . .) Cutworms. (Dark worms which cut off plant just above ground.)	Nicotine sulphate . . . . .	Same treatment as for cucumbers . . . . .	do . . . . .	do . . . . .	Thrips cause the onion leaves to become silvery or whitened and later curled and twisted.
Parsley . . . . .						Not likely to be injured by pests.
Parsnip . . . . .						Not likely to be injured by pests.
Peas . . . . .	Powdery mildew. (Covers entire plant with a powdery white growth.)	Pulverized sulphur or flowers of sulphur, or Bordeaux.	Sprinkle on plants when mildew appears.	Repeat if necessary . . . . .	Two weeks later . . . . .	Usually the garden crop does not need treatment for diseases.

Pea aphis.....	Same as for bean aphids, which see.						Aphids are usually not troublesome in the garden.
Pepper.....							Not likely to be injured by pests.
Potato.....	Early blight. (Brown spots with concentric rings on leaves.) Late blight. (Spots on leaves are dark brown and look water-soaked; they do not have concentric rings. Spots become yellow and leaves die.) Colorado potato beetle. (This is the common "potato bug" which eats the leaves.) Blister beetle or long black potato bug, or old-fashioned potato bug. (Eats leaves.) Flea beetle. (Small jumping insect which eats the leaves.)	Bordeaux..... do..... Arsenate of lead..... Same remedy as for Colorado potato beetle above. Same remedy as for Colorado potato beetle above. Spray as repellent.	When plants are 6 inches high. do..... When beetles appear.....	2 weeks later..... do..... Repeat when necessary	2 weeks later..... do..... Repeat when necessary	This disease comes early in the season and is worst in moist weather. This disease is worst in hot sultry weather in August and September. Disease from the plants lives over winter on seed potatoes. The beetles are often hand picked or jarred into a vessel containing water with a little kerosene. Flea beetles usually appear early when potato plants are small.	
Pumpkin.....	Diseases, insects, and remedies same as cucumber, which see.						
Radish.....	Cabbage maggot. (Small worms which tunnel into the radish.)	Tobacco dust sprinkled along row when seed is planted, or sand sprinkled with kerosene scattered along the row when plants are small will repel the maggot.				Burn all plants infested with maggots.	
Rhubarb.....	Flea beetle. (Eats small holes in the leaves.)	The same remedy for flea beetle of potato, which see.	When beetles appear.....	Repeat if necessary.			
Rutabaga.....						May be attacked by the same pests as cabbage, and treatment is the same as given under cabbage, which see.	
Salsify.....						Not likely to be injured by pests.	
Spinach.....	Aphids. (Suck sap from leaves.)	Nicotine sulphate.....	Repeat if necessary.....	Repeat if necessary.....			
Squash.....	Insects, diseases, and remedies same as cucumber, which see.	When aphids appear. Spray underside of leaves.				Soon after transplanting to garden.	
Tomato.....	Leaf spot or blight. (Leaves become spotted, turn yellow and drop; stems dry up and fruits drop.) Fruit rot. (Decay begins at blossom end of fruit.)	Bordeaux. Spraying not entirely effective. No effective remedy.	While plants are small in seed box or seed bed.	3 weeks later.....	If disease is present spray every 3 weeks.	Cultivate well, and water according to the needs of the plants. The variety Bonny Best is usually free from this disease.	

Plant.	Disease or insect.	Spray to use.	First spraying.	Second spraying.	Third spraying.	Remarks.
Tomato.....	Anthracnose. (Causes sunken discolored spots in fruit, which then decays.) Wilt. (Plants wilt and die)..... Tomato worms. (Large green, naked caterpillars which eat the leaves.) Cutworms. (Dark worms which cut plants off at the surface of the ground.) Flea beetle. (Small jumping beetle which eats small holes in leaves.)	Same treatment as for leaf spot. Pull up and burn plants. Hand pick and kill the worms. Same treatment as mentioned under cabbage. Same treatment as mentioned under potatoes.				These seldom appear in large numbers.
Turnip.....	Liable to have same diseases as cabbage, which see.		Same as for cabbage, which see.			
Watermelon.....	Anthracnose. (Brown spots on leaves, small sunken spots on fruit.) Insects same as cucumber and muskmelon, which see.	Bordeaux.....	When melons are half grown.	10 days later.....		Repeat if necessary.....



